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LYMPHATIC SYSTEM OF THE CORNEA.

By G. THIN, M.D.

Extracted from a Paper published in the "LANCET" *of February* 14*th*, 1874.

With the Author's Compliments

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I HAVE frequently observed in sections of the cornea treated in the usual way by nitrate of silver and chloride of gold singly and combined, appearances that I could only explain by supposing the existence of epithelium-lined lymphatic vessels running through the structure. Recently, in re-examining preparations that had been laid aside for a time, I found that in some of them these appearances had developed to an extent and precision that place the existence of lymphatic vessels in the cornea beyond doubt.

Figs. 1 and 2 are drawn from two of these preparations. I have succeeded since in obtaining preparations equally characteristic in sections of the cornea within a few days after they were excised and subjected to the influence of the metallic solutions.

Fig. 1 represents the largest lymphatic vessel I have seen, and from its size shows well the specially distinctive epithelium of the lymphatics. Fig. 2 shows smaller vessels joining to form a larger trunk, and their relative position to the substantia propria of the cornea. They are from the rabbit.

Those who are familiar with the appearances presented by the lymphatics as demonstrated by the use of nitrate of silver in the diaphragm of the rabbit or guinea-pig, will at once identify these drawings as representing similar anatomical structures. Those who are not familiar with these appearances can satisfy themselves that they are the same by referring to the woodcuts in the works of von Recklinghausen and Klein.

A reference to Bowman's description of the corneal tubes shows how accurately, even to the varicosities, it applies to the lymphatics, and I cannot help coming to the conclusion that the mercury in his injections took the course offering least resistance, that along the lymphatic vessels.

The clear spaces in Figures 1 and 2 correspond to the lacunæ of the cornea, in which the cornea corpuscles or cells lie; and it will be observed that they communicate directly with each other, and, through those that are adjacent to the vessel, with the lymphatic system. The dark colour of the lines between epithelial cells being due to the action of the nitrate of silver on the connecting substance, if the silver solution has penetrated only as far as the vessels, the epithelium of the vessels only is seen, as in Figures 1 and 2. But if the nitrate of silver is brought into contact with the free surface of the lacunæ, it is found that THE EPITHELIUM IS CO-EXTENSIVE WITH THE WHOLE CANALICULAR SYSTEM.

Figure 3 is drawn from a preparation which shows the direct continuation of the epithelium of a lymphatic vessel into that lining the lacunæ or corneal spaces.

In studying the relations of the nerves to the lymphatic trunks, I have been repeatedly able to trace the epithelial markings in the vessel into the spaces on each side.

As far as I know, Hoyer* and Schweigger-Seidel† are the

* Reichert u. Du Bois-Reymond's Arch. s. 204. 1865.

† Sitzungs Bericht der K. sachsischen Gesellschaft der Wissenschaften. Math. Phys. Classe. 1869.

only observers who have figured dark lines in a clear field in drawings illustrating preparations from corneæ treated with silver, and I believe the lines they figure to be the same as those which I interpret as epithelial. As I understand Hoyer, he believed these lines to be produced by the action of the silver on the surface of the cornea-corpuscle. "Wenn nun also die in der Hornhautsubstanz ausgegrabenen Lücken und Kanälchen einerseits von Zellen und ihren Fortsätzen wirklich ausgefüllt sind, die selbst keine Silberkörnchen einschliessen, andererseits der Niederschlag dennoch in dem Lückensystem enthalten ist, so kann er sich nur zwischen der Wand und dem Inhalte der Lücken, also auf der Oberfläche der Zellen und ihrer Ausläufer abgelagert haben."

To explain them Schweigger-Seidel constructed a new scheme of the anatomy of the cornea. The lacunæ are, according to him, mere clefts in the fibrillary substance, which on one side only are covered with "cornea-cells," one side of the cell being fixed to the fibrillary structure, and the other being free towards the cleft in the fibrillary substance. His cornea-cells differ from what is generally understood as a cornea-cell or corpuscle. What is accepted as the nucleus of the cornea-corpuscle is, according to him, the nucleus of a flat cell (*platten*), the cornea-corpuscle having no individuality (if I may use the term), and no nucleus, and being simply a movable substance, to which it is doubtful if the term "protoplasm" can be applied.

The figures of his isolated cornea cells probably represent the epithelium of the spaces. His theory of the non-existence of the cornea-corpuscle as an independent protoplasmic mass has not found, and is not likely to find, support.

Rollett,* in referring to the dark lines of Hoyer and Schweigger-Seidel, gives another explanation of them. He says that they are only to be found in young animals, and can be demonstrated in every young rabbit; that they

* Stricker's Handbook. Art. "Cornea."

mark, indeed, the limits of two adjoining cells, but that the cells are the cornea cells (corpuscles) which have not yet been separated by the growth of the fibrillary cornea substance. "It is certain," he remarks, "that the appearance is not to be seen in the developed cornea layers of grown animals." In reference to Rollett's theory, I have only to remark that the corneæ from which sections are drawn in Figs. 3 and 4 were taken from an adult bitch pregnant at the time of their removal.

In a cornea that has been treated first with silver and then with gold, and in which the special effects proper to each metal have been produced, the lymphatic is brought out by the silver, whilst the nerve coloured by the gold is seen lying in the vessel and nearly filling it. A narrow clear space is distinctly visible between the nerve and the wall of the lymphatic.

Fig. 4 is from a preparation obtained by this method from the same cornea as Fig. 3, and has been selected because in making the section the knife has happened to carry away a part of the nerve-trunk, and has thus made the relations of the nerve to the lymphatic vessel very apparent. In other preparations from the same cornea, in which the nerve, lymphatic wall, and the clear space between them were distinctly visible, I have seen very clearly the continuation of the same relation from the main stem into the nerve-branches and smaller lymphatics.

It has not come within the scope of the present paper to treat specially of the cornea-corpuscles. As showing that Figs. 3 and 4 are from a normal cornea, I may mention that in sections from the same cornea, in which the chloride of gold had acted exclusively, I saw the usual beautiful webbed network of anastomosing corpuscles with oval nuclei lying in an otherwise perfectly clear field. In comparing the size of these corpuscles with that of the lacunæ, the conviction is inevitable that the fluid-filled space which the

easy passage of white cells in the cornea shows to exist between the epithelium and the corpuscle, must, in the normal condition, be very narrow.

In Fig. 4 the corpuscles are represented in several of the spaces fractionally and imperfectly, as they happened to be seen in the preparation.

In conclusion, I would suggest whether the dark and clear fields seen in all silver-corneæ may not be produced by a special power on the part of the epithelium to resist the absorption and reduction of the nitrate.

To Mr. J. C. Ewart, of the University of Edinburgh, for the care and fidelity with which he has executed the drawings, my best thanks are due.

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EXPLANATION OF FIGS. 1, 2, 3, & 4.

(*Magnifying power:* Hartnack Objective 7; Eye-piece 4.)

a, Lymphatic vessel. *b*, Line between the epithelial cells of the lymphatic vessel. *e*, Free opening from the lacunæ of the cornea into the lymphatic vessel. *d*. Substantia propria of the cornea. *e*, Corneal space (lacuna). *f*, Line between epithelial cells in the lacunæ. *g*, Nerve-stem. *h*, Branch of nerve. *i*, Anastomosis between two cornea-corpuscles. *k*, Cornea-corpuscle (tinting incomplete).

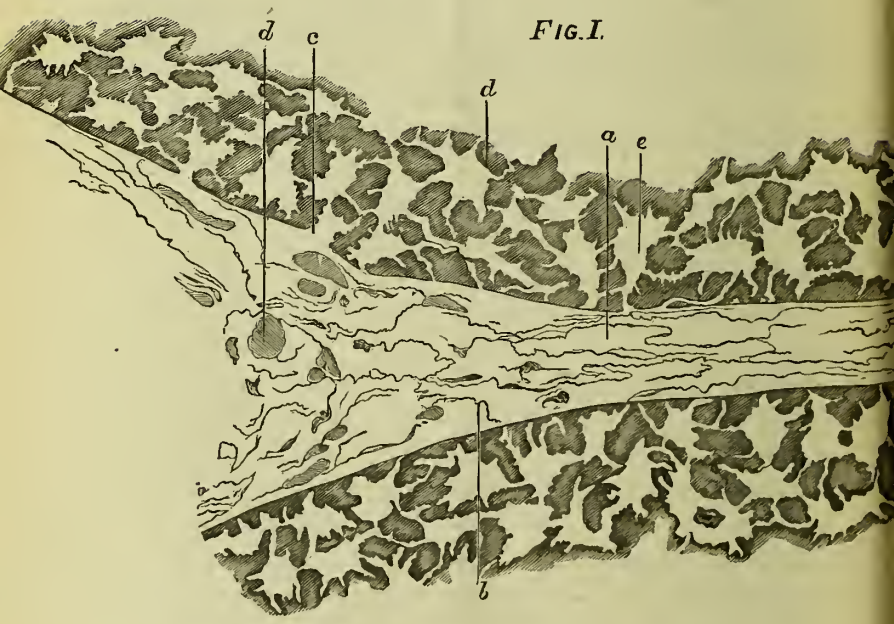

FIG. I.

Fig. 2.

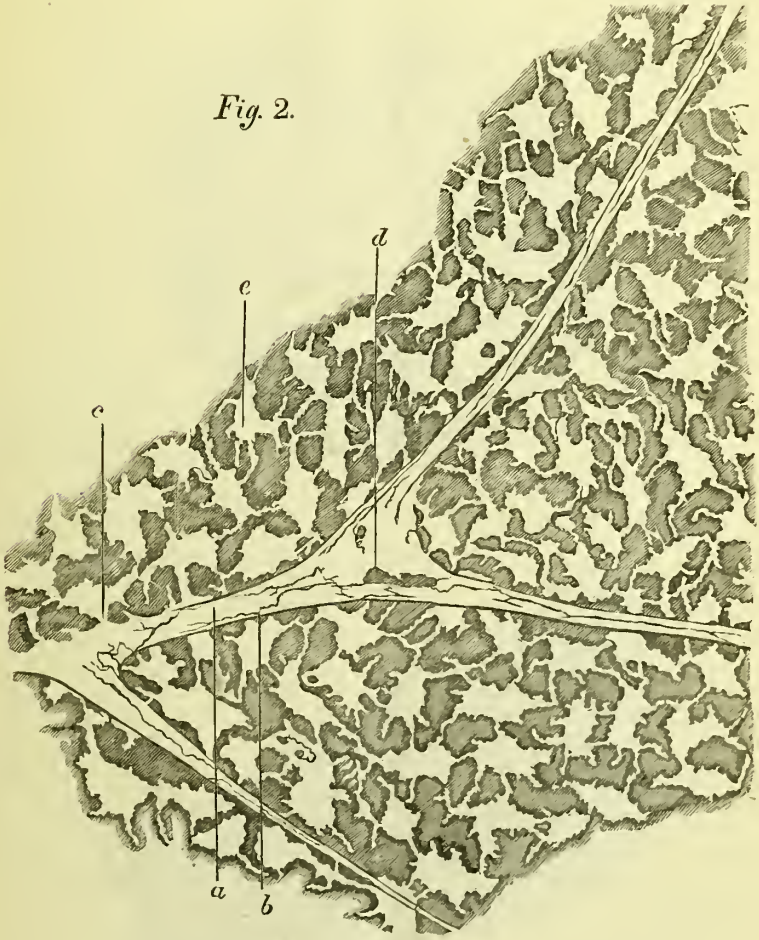

Fig. 3.

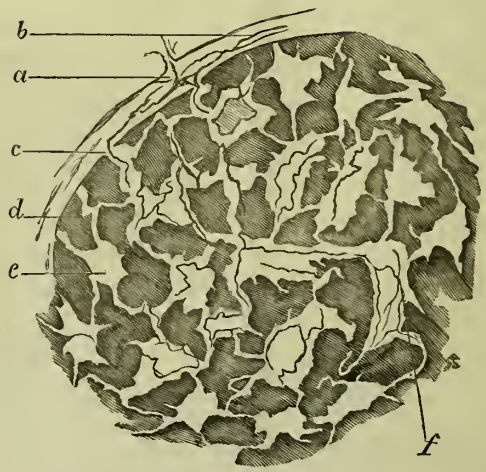

Fig. 4.